Space Weather Technical Forecast

Issued on Friday, 07 January 2022 at 00:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of minor geomagnetic activity day 2 (8th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the past 24 hours, with mostly B-flares observed. There are two sunspot regions on the visible disc; AR2924 Esi/Beta and AR2925 Hsx/Alpha, both located in the southeast quadrant. No Earth-directed CMEs have been observed from currently available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as observed at L1 started the period slightly elevated, around 400-420km/s before declining to slow-ambient levels, at around 340km/s by the end of the period. Density has been near or slightly below average. The interplanetary magnetic field strength (IMF Bt) was weak at around 5nT, with a mostly positive Bz value. The Phi angle has also been mainly positive (away from the Sun). Geomagnetic activity has been Quiet (Kp 0).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. High energy electron flux (greater than 2MeV) remained at moderate levels. Electron fluence remained below the Active threshold (1e8), with a generally level trend, and 4.08e7 integrated pfu was recorded at 07/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain low or very low with a 50% chance of C-class flaring from either of the sunspots on the disc. New or returning previous regions are anticipated to rotate onto the visible disc through the period. Therefore solar activity may increase, bringing a slight chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: There are currently no Earth-directed CMEs. Solar winds are expected to remain mainly slow-ambient until day 2 (8th) when a CIR and the arrival of a coronal hole fast wind is anticipated. Quiet geomagnetic conditions are likely until then, becoming Unsettled to Active (Kp 3-4) from day 2 (8th Jan) with a chance of G1/Minor storm intervals (Kp 5).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels in the absence of solar activity. The High energy electron flux (greater than 2MeV) may temporarily exceed the High (1e3pfu) threshold at the diurnal peaks, mainly on day 1 (7th), and also on day 3 (9th). Otherwise the high energy flux will persist at generally moderate levels. The electron fluence is expected to remain below the Active level (1e8 integrated pfu), with a generally steady trend.

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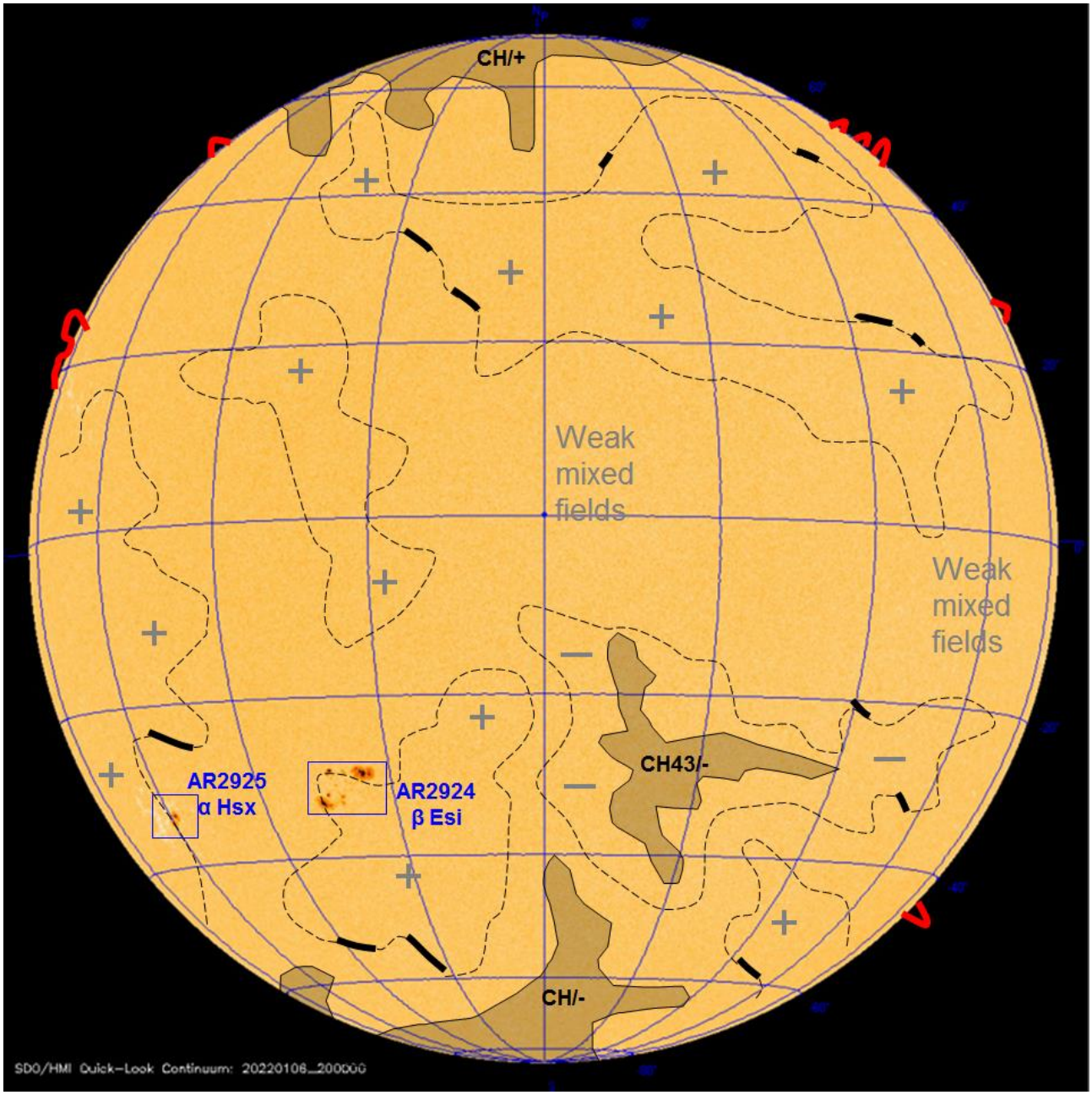
Figure 1. Solar Analysis Valid 2000UTC, 6 January 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

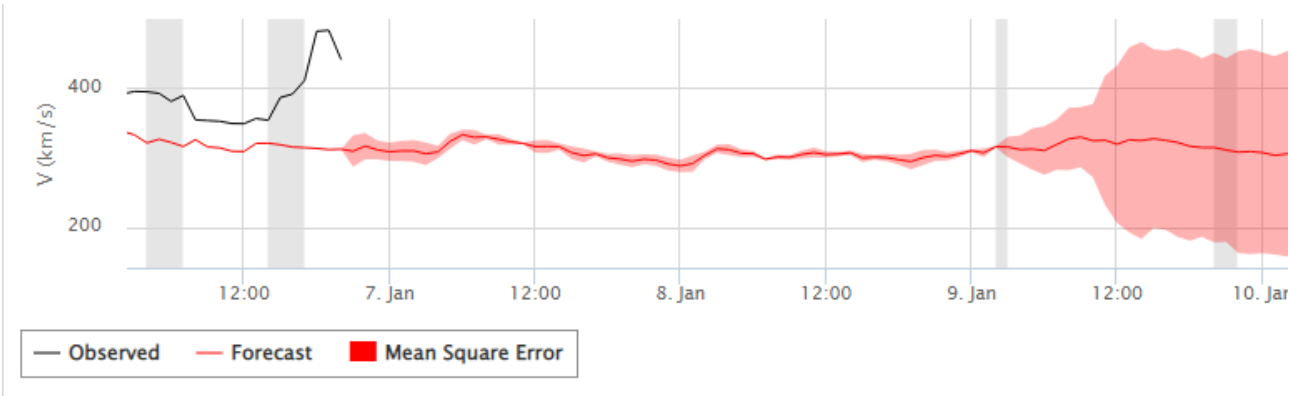
There are currently no Earth-directed CMEs. Slow-ambient solar winds continuing with no features expected until the CIR and fast wind of CH43 (-ve) arrives through day 2 (8th). This is a new feature on this rotation, with the coronal hole becoming more prominent. Therefore confidence is moderate on timing and strength, with a best estimate of predicted elevated solar winds around 500km/s, as roughly indicated by STEREO A. A Solar Sector Boundary Crossing (SSBC) may also precede the coronal hole, but currently we are connected to a positive region of the current sheet (Phi Angle is currently positive) and the coronal hole is negative. This may allow for a temporary unsettled period in geomagnetic activity.
Quiet geomagnetic activity is forecast until day 2 (8th Jan), with Unsettled to Active and a Chance of G1/Minor Storms for a 24 to 36 hour period. Activity probably returning back to Quiet again by day 4 (10th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	20	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Met Office Solar Winds Prediction Model (SWPM) indicating little change to solar winds, and does not reflect expectations with the 'new' coronal hole giving the HSS on day 2 (8th).



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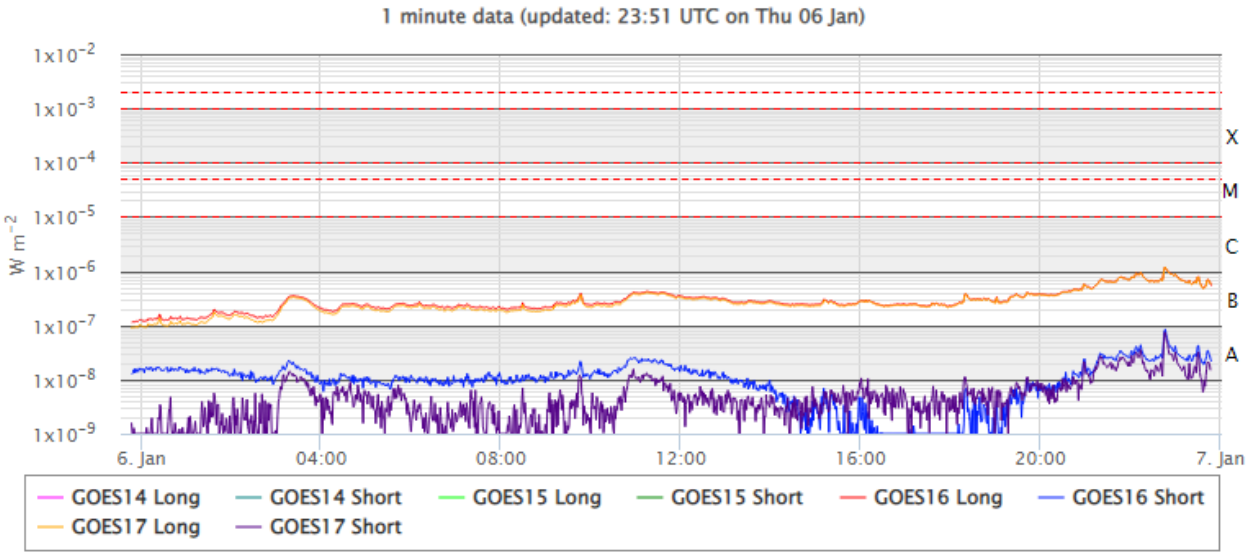
Radio Blackouts - X-Ray Flares:
Solar Activity is currently Low. There are two sunspot regions on the visible disc; AR2924 Esi/Beta and AR2925 Hsx/Alpha, both in the southeast quadrant. AR2925 was potentially ex-2906 on the previous rotation. New or returning previous regions will potentially rotate onto the visible disc throughout the period, especially on day 2 (8th). This corresponds to the region of ex-2907 and ex-2908 on the previous rotation, both of which produced M-flares on their previous transit across the Sun.
Low or Very Low solar activity is expected to persist, but may increase with the potential arrival of new or returning regions, bringing a slightly raised chance of isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES X-ray flux showing little in the way of flare activity over the past 24 hours.



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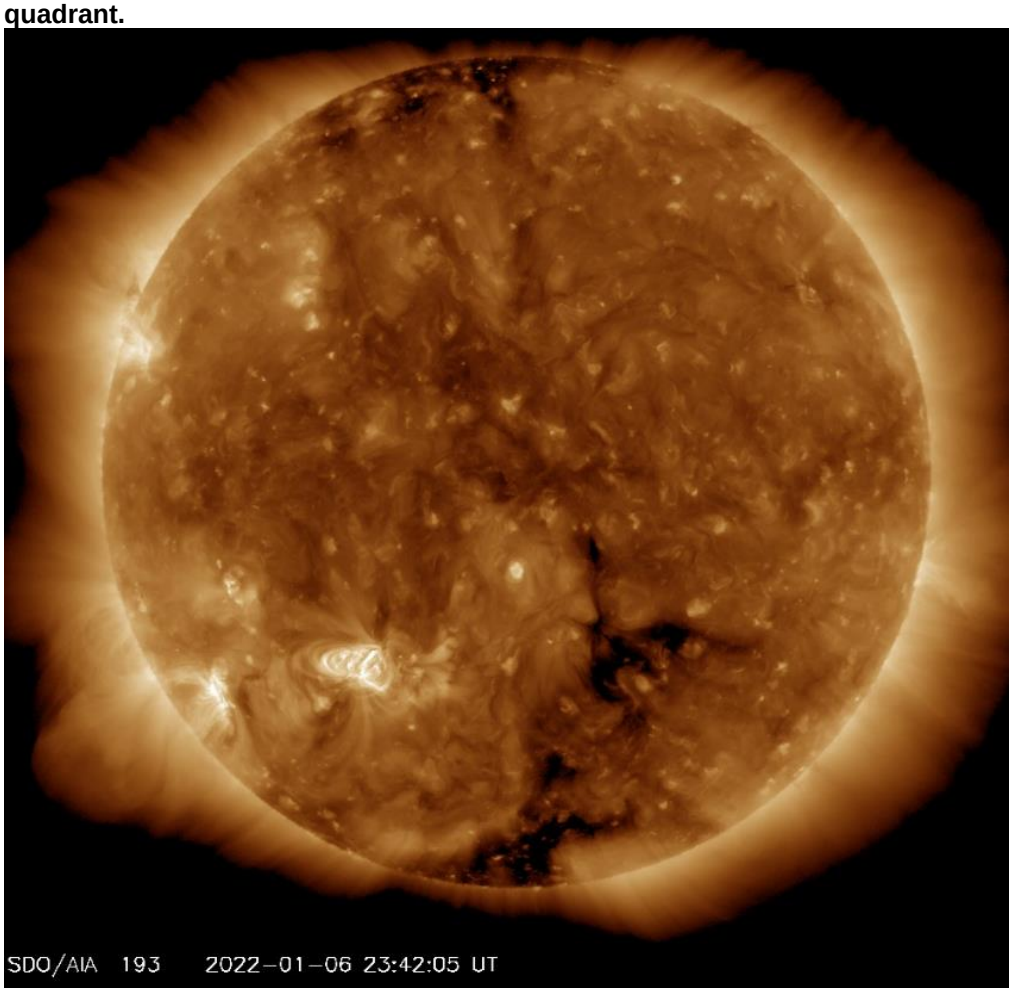
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is currently at background levels and will most likely persist at this level in the absence of solar activity.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO-aia 193 satellite imagery showing location of Coronal Hole 43/- in the southwest quadrant.



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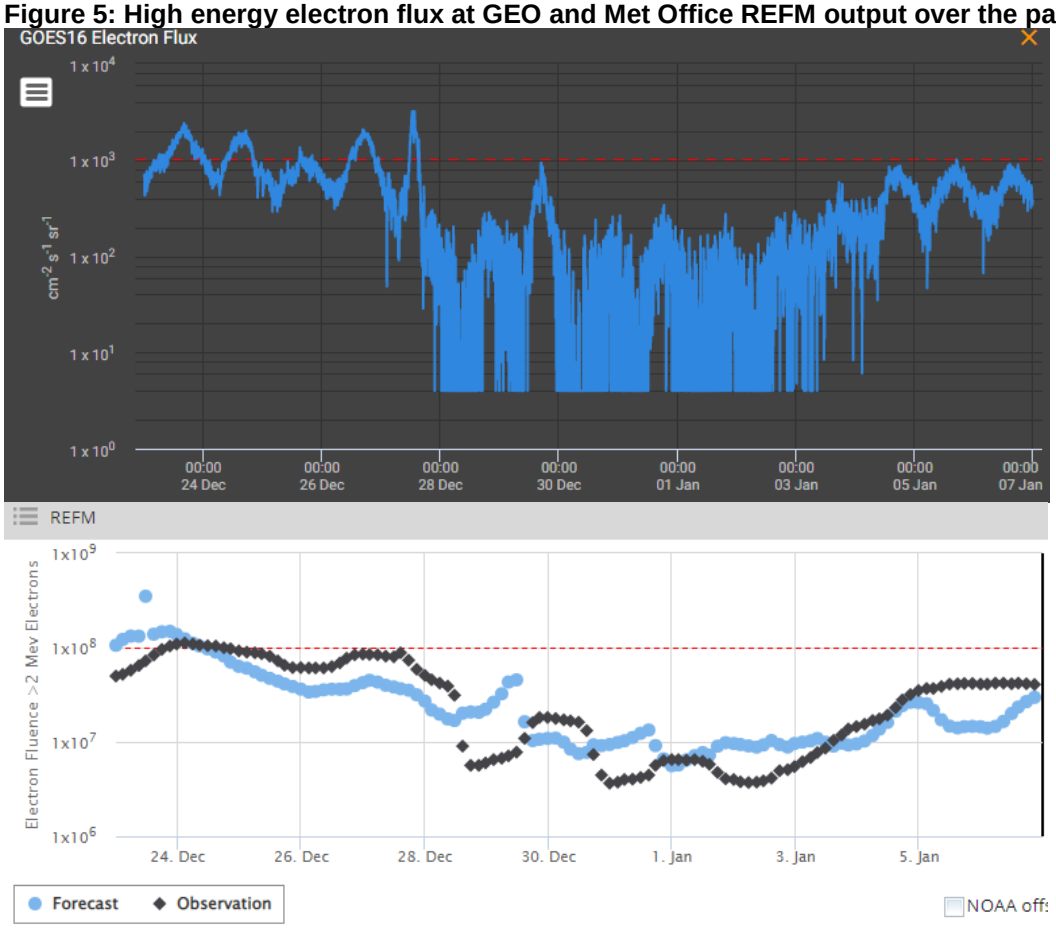
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) as observed by GOES-16 is currently at predominately moderate levels, but diurnal peak values are expected to be close to, or temporarily just exceed, the High threshold of 1e3pfu. This is especially likely today and day 4 (9th), while expected slightly enhanced geomagnetic activity suppresses the electron count during day 2.

The electron fluence is expected to remain below the Active level (1e8 integrated pfu). Met Office REFM guidance appears to be offering good guidance, keeping the fluence below the Active threshold, but a generally steady or even gently rising trend is preferred against the REF model's decreasing trend.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	15	10	5	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO and Met Office REFM output over the past 2 weeks.



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